

**WE CLAIM:**

1. A multi-layer circuit board comprising:

at least two metal layers and at least two signal wiring layers disposed one above the other, at least one of said metal layers being a ground metal layer, at least one of said metal layers being a power metal layer; and

a plurality of insulating substrates disposed sequentially one above the other, each adjacent pair of said metal layers and said signal wiring layers being spaced apart by one of said insulating substrates;

wherein at least one of said signal wiring layers is suitable for high-speed low-impedance signal transmission and has a resistance relative to an adjacent one of said metal layers that is within the range of 25.2 to 30.8 ohms;

said at least one of said signal wiring layers that is suitable for high-speed low-impedance signal transmission being separated from the adjacent one of said metal layers by an adjacent one of said insulating substrates, which is made from a first insulator material having a first dielectric coefficient;

the other ones of said insulating substrates that are not adjacent to said at least one of said signal wiring layers being made of a second insulator material having a second dielectric coefficient that is lower than the first dielectric coefficient.

2. The multi-layer circuit board of Claim 1, wherein the second dielectric coefficient is about 4.5.

3. The multi-layer circuit board of Claim 1, wherein the first dielectric coefficient is greater than 4.5.

5 4. The multi-layer circuit board of Claim 1, wherein the second insulator material is glass fiber reinforced epoxy resin.

10 5. The multi-layer circuit board of Claim 1, wherein the first insulator material is ceramic filled polytetrafluoroethylene.

6. The multi-layer circuit board of Claim 1, wherein the first insulator material has a dissipation factor of about 0.002.

15 7. The multi-layer circuit board of Claim 1, wherein:  
said insulating substrates include first, second and third insulating substrates disposed sequentially one above the other;

20 said signal wiring layers including a first signal wiring layer disposed on one side of said first insulating substrate opposite to said second insulating substrate, and a second signal wiring layer disposed on one side of said third insulating substrate opposite to said second insulating substrate;

25 said power metal layer being disposed between said first and second insulating substrates;

said ground metal layer being disposed between said second and third insulating substrates;

said first and third insulating substrates being made from the first insulator material;

said second insulating substrate being made from the second insulator material.

5 8. The multi-layer circuit board of Claim 1, wherein:

said insulating substrates include first, second, third, fourth and fifth insulating substrates disposed sequentially one above the other;

10 said signal wiring layers including a first signal wiring layer disposed on one side of said first insulating substrate opposite to said second insulating substrate, a second signal wiring layer disposed between said second and third insulating substrates, a third signal wiring layer disposed between said third and  
15 fourth signal wiring layers, and a fourth signal wiring layer disposed on one side of said fifth insulating substrate opposite to said fourth insulating substrate;

said ground metal layer being disposed between said first and second insulating substrates;

20 said power metal layer being disposed between said fourth and fifth insulating substrates.

9. The multi-layer circuit board of Claim 8, wherein said first and fifth insulating substrates are made from the first insulator material, and said second, third  
25 and fourth insulating substrates are made from the second insulator material.

10. The multi-layer circuit board of Claim 8, wherein said first and fifth insulating substrates are made from the second insulator material, and said second, third and fourth insulating substrates are made from the first insulator material.

11. The multi-layer circuit board of Claim 1, wherein: said insulating substrates include first, second, third, fourth, fifth, sixth and seventh insulating substrates disposed sequentially one above the other;

said signal wiring layers including a first signal wiring layer disposed on one side of said first insulating substrate opposite to said second insulating substrate, a second signal wiring layer disposed between said second and third insulating substrates, a third signal wiring layer disposed between said fifth and sixth insulating substrates, and a fourth signal wiring layer disposed on one side of said seventh insulating substrate opposite to said sixth insulating substrate;

said metal layers including a first one of said ground metal layers disposed between said first and second insulating substrates, a second one of said ground metal layers disposed between said third and fourth insulating substrates, said power metal layer disposed between said fourth and fifth insulating substrates, and a third one of said ground metal layers disposed between said sixth and seventh insulating substrates.

12. The multi-layer circuit board of Claim 11, wherein said first and seventh insulating substrates are made from the first insulator material, and said second, third, fourth, fifth and sixth insulating substrates are made from the second insulator material.

13. The multi-layer circuit board of Claim 11, wherein said second and third insulating substrates are made from the first insulator material.

14. The multi-layer circuit board of Claim 11, wherein said fifth and sixth insulating substrates are made from the first insulator material.

15. The multi-layer circuit board of Claim 11, wherein said second, third, fifth and sixth insulating substrates are made from the first insulator material, and said first, fourth and seventh insulating substrates are made from the second insulator material.

16. The multi-layer circuit board of Claim 1, wherein:  
said insulating substrates include first, second, third, fourth, fifth, sixth, seventh, eighth and ninth insulating substrates disposed sequentially one above the other;

said signal wiring layers including a first signal wiring layer disposed on one side of said first insulating substrate opposite to said second insulating substrate, a second signal wiring layer disposed between said second and third insulating substrates, a third signal wiring layer disposed between said third and

fourth insulating substrates, a fourth signal wiring layer disposed between said sixth and seventh insulating substrates, a fifth signal wiring layer disposed between said seventh and eighth insulating substrates, and a sixth signal wiring layer disposed on one side of said ninth insulating substrate opposite to said eighth insulating substrate;

said metal layers including a first one of said ground metal layers disposed between said first and second insulating substrates, a second one of said ground metal layers disposed between said fourth and fifth insulating substrates, said power metal layer disposed between said fifth and sixth insulating substrates, and a third one of said ground metal layers disposed between said eighth and ninth insulating substrates.

17. The multi-layer circuit board of Claim 16, wherein said first and ninth insulating substrates are made from the first insulator material, and said second, third, fourth, fifth, sixth, seventh and eighth insulating substrates are made from the second insulator material.

18. The multi-layer circuit board of Claim 16, wherein said second, third and fourth insulating substrates are made from the first insulator material.

19. The multi-layer circuit board of Claim 16, wherein said sixth, seventh and eighth insulating substrates are made from the first insulator material.

20. The multi-layer circuit board of Claim 16, wherein said second, third, fourth, sixth, seventh and eighth insulating substrates are made from the first insulator material, and said first, fifth and ninth insulating substrates are made from the second insulator material.

21. The multi-layer circuit board of Claim 1, wherein:

said insulating substrates include first, second, third, fourth, fifth, sixth, seventh, eighth, ninth, tenth and eleventh insulating substrates disposed sequentially one above the other;

said signal wiring layers including a first signal wiring layer disposed on one side of said first insulating substrate opposite to said second insulating substrate, a second signal wiring layer disposed between said second and third insulating substrates, a third signal wiring layer disposed between said fifth and sixth insulating substrates, a fourth signal wiring layer disposed between said sixth and seventh insulating substrates, a fifth signal wiring layer disposed between said ninth and tenth insulating substrates, and a sixth signal wiring layer disposed on one side of said eleventh insulating substrate opposite to said tenth insulating substrate;

said metal layers including a first one of said ground metal layers disposed between said first and second insulating substrates, a first one of said power metal layers disposed between said third and fourth insulating

substrates, a second one of said ground metal layers disposed between said fourth and fifth insulating substrates, a second one of said power metal layers disposed between said seventh and eighth insulating substrates, a third one of said ground metal layers disposed between said eighth and ninth insulating substrates, and a fourth one of said ground metal layers disposed between said tenth and eleventh insulating substrates.

22. The multi-layer circuit board of Claim 21, wherein said first and eleventh insulating substrates are made from the first insulator material, and said second, third, fourth, fifth, sixth, seventh, eighth, ninth and tenth insulating substrates are made from the second insulator material.

23. The multi-layer circuit board of Claim 21, wherein said second and third insulating substrates are made from the first insulator material.

24. The multi-layer circuit board of Claim 21, wherein said ninth and tenth insulating substrates are made from the first insulator material.

25. The multi-layer circuit board of Claim 21, wherein said second, third, ninth and tenth insulating substrates are made from the first insulator material, and said first, fourth, fifth, sixth, seventh, eighth and eleventh insulating substrates are made from the second insulator material.



26. The multi-layer circuit board of Claim 21, wherein said fifth, sixth and seventh insulating substrates are made from the first insulator material, and said first, second, third, fourth, eighth, ninth, tenth and eleventh insulating substrates are made from the second insulator material.

27. The multi-layer circuit board of Claim 1, wherein:

said insulating substrates include first, second, third, fourth, fifth, sixth, seventh, eighth, ninth, tenth, eleventh, twelfth, thirteenth, fourteenth and fifteenth insulating substrates disposed sequentially one above the other;

said signal wiring layers including a first signal wiring layer disposed on one side of said first insulating substrate opposite to said second insulating substrate, a second signal wiring layer disposed between said second and third insulating substrates, a third signal wiring layer disposed between said fifth and sixth insulating substrates, a fourth signal wiring layer disposed between said sixth and seventh insulating substrates, a fifth signal wiring layer disposed between said ninth and tenth insulating substrates, a sixth signal wiring layer disposed between said tenth and eleventh insulating substrates, a seventh signal wiring layer disposed between said thirteenth and fourteenth insulating substrates, and an eighth signal wiring layer disposed on one side of said fifteenth insulating

substrate opposite to said fourteenth insulating substrate;

said metal layers including a first one of said ground metal layers disposed between said first and second insulating substrates, a first one of said power metal layers disposed between said third and fourth insulating substrates, a second one of said ground metal layers disposed between said fourth and fifth insulating substrates, a second one of said power metal layers disposed between said seventh and eighth insulating substrates, a third one of said ground metal layers disposed between said eighth and ninth insulating substrates, a third one of said power metal layers disposed between said eleventh and twelfth insulating substrates, a fourth one of said ground metal layers disposed between said twelfth and thirteenth insulating substrates, and a fifth one of said ground metal layers disposed between said fourteenth and fifteenth insulating substrates.

28. The multi-layer circuit board of Claim 27, wherein said first and fifteenth insulating substrates are made from the first insulator material, and said second, third, fourth, fifth, sixth, seventh, eighth, ninth, tenth, eleventh, twelfth, thirteenth and fourteenth insulating substrates are made from the second insulator material.

29. The multi-layer circuit board of Claim 27, wherein said second and third insulating substrates are made from the first insulator material.

5 30. The multi-layer circuit board of Claim 27, wherein said thirteenth and fourteenth insulating substrates are made from the first insulator material.

10 31. The multi-layer circuit board of Claim 27, wherein said second, third, thirteenth and fourteenth insulating substrates are made from the first insulator material, and said first, fourth, fifth, sixth, seventh, eighth, ninth, tenth, eleventh, twelfth and fifteenth insulating substrates are made from the second insulator material.

15 32. The multi-layer circuit board of Claim 27, wherein said fifth, sixth and seventh insulating substrates are made from the first insulator material.

33. The multi-layer circuit board of Claim 27, wherein said ninth, tenth and eleventh insulating substrates are made from the first insulator material.

20 34. The multi-layer circuit board of Claim 27, wherein said fifth, sixth, seventh, ninth, tenth and eleventh insulating substrates are made from the first insulator material, and said first, second, third, fourth, eighth, twelfth, thirteenth, fourteenth and fifteenth  
25 insulating substrates are made from the second insulator material.